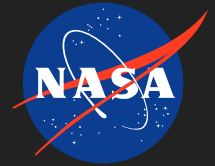


Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

Completed Technology Project (2005 - 2009)



Project Introduction

Objective: Depression could present a threat to the success and safety of long-duration space missions, and crews need the ability to manage it effectively. The primary objective of this study was to develop a self-guided interactive multimedia program that is capable of facilitating clinical improvement in persons with depression, when used in an entirely self-help format. Software developed through this study enables evidence-based treatment for depression to be made available to astronauts at any time in any location. It could be used autonomously or in combination with other medical resources.

(1) Original aims of the project:

1. Complete the development of a training module to recognize and prevent depression.
2. Develop a module to implement computer-based Problem-Solving Treatment (PST), an evidence-based treatment for depression.
3. Evaluate the efficacy of the computer-delivered PST module for depression in a randomized controlled trial.

(2) Key findings of the project: To address Aim 1, we produced a brief training video, in which Dr. Mark Hegel discusses the signs and symptoms of depression, how it can affect performance, and how it can be treated. A self-assessment of depression was created in a previous study, and already exists in the system. There is evidence from other studies that going through a course of PST can help prevent the future onset of depression in at-risk populations. Therefore, Aim 1 was addressed via the training video and the PST program, itself.

Addressing Aim 2 was the most challenging and time-consuming part of this project: designing and producing a fully-automated self-treatment program for depression. The end product was a 6-session interactive media program in which users are guided step-by-step through a full course of PST, an evidence-based treatment for depression. Each session involves a coach (Dr. Mark Hegel, a psychologist who is an expert in PST) who appears in numerous video and audio clips to help users/patients proceed through the stages of the treatment. The program was designed to exercise a form of "clinical judgment," by helping users/patients troubleshoot ways to improve their work on particular problems. The program also tracks 9 variables which are utilized to analyze the user's/patient's work across sessions and problems, and give suggestions on how to improve their problem-solving success, in general. This work has resulted in what appears to be the most sophisticated self-help program ever developed, in terms of media usage and data handling. It includes 247 audio and 160 video files to tailor the PST session to the individual.

Aim 3 was addressed via a randomized clinical trial pilot study, comparing the



Self-guided Depression
Treatment on Long-duration
Space Flights: A Continuation
Study

Table of Contents

Project Introduction	1
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Anticipated Benefits	3
Technology Areas	3
Target Destinations	3
Primary U.S. Work Locations and Key Partners	4
Project Transitions	5
Stories	5
Project Website:	6

Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

Completed Technology Project (2005 - 2009)



PST program to a 7-week waitlist control condition. We had originally planned to include 68 persons with minor depression in the study; however, the time required to complete development of the PST intervention program precluded enrolling this number. Therefore, we enrolled 14 persons in a pilot study (7 in the experimental group and 7 in the control group). The mean age of participants was 50 years, and all had completed at least 4 years of college, making them somewhat analogous to the astronaut population. The primary outcome was depression, as measured via the Hamilton Depression Inventory (HDI). No differences were found between groups on the HDI at pre-test.

We partnered with another NSBRI (National Space Biomedical Research Institute) study (PI: Dr. Gary Strangman), by sharing some participants. Participants were to be evaluated via magnetic resonance imaging (MRI) and near-infrared spectroscopy at 3 points: pre-treatment, mid-treatment (between sessions 3 and 4), and post-treatment. Unfortunately, MRI malfunctions and scheduling problems caused 2 of the 7 participants assigned to the experimental group to have a 4- and a 9-week lapse between sessions 3 and 4. Because our a-priori study procedures called for participants who lapse for more than 3 weeks between sessions to be removed from the study, data from these 2 participants were not included in the final analysis. We did, however, allow them to complete the final 3 sessions, since they wished to continue and had not caused the lapse of time. Also, one control group participant dropped out, leaving 6 in that group.

Percent change was compared using Kruskal-Wallis Chi Square at pre- and post-treatment for the experimental group and pre- and post- a no-treatment period of 7 weeks for the control group. A 52.65% reduction in depression was found for the 5 experimental group participants, whereas an 11.12% reduction was found for the control group. The difference in percent change was significant ($p < .04$), and an extremely high effect size was found (Cohen's $d = 1.73$).

It is notable that if data from the 2 persons who lapsed longer than 2 weeks is included, the percent change is not significant, which suggests that if the treatment is used as recommended (i.e., with no more than a 3-week lapse between sessions), it is likely to help, but if not used as recommended, it is unlikely to help. It is also notable that no subjects ever "no-showed" for a scheduled PST session with the software.

(3) Impact of findings on specific aims of the original proposal. The specific aims were addressed, although the final number of participants enrolled was fewer than originally planned. The program shows strong promise as a new intervention, but requires further validation in a larger sample.

(4) Proposed research plan for coming year. We plan to apply for funding from

Organizational Responsibility

Responsible Mission Directorate:

Space Operations Mission Directorate (SOMD)

Lead Organization:

National Space Biomedical Research Institute (NSBRI)

Responsible Program:

Human Spaceflight Capabilities

Project Management

Program Director:

David K Baumann

Principal Investigator:

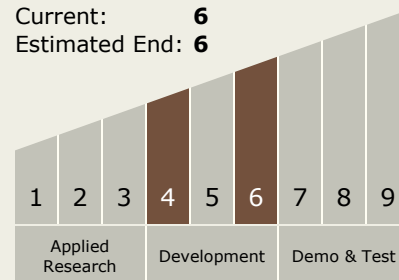
James A Cartreine

Co-Investigators:

Steven Locke
Mark Hegel
Jay C Buckey

Technology Maturity (TRL)

Start: 4
Current: 6
Estimated End: 6



Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

Completed Technology Project (2005 - 2009)



other sources to conduct a large-scale randomized trial of the PST program's efficacy. We anticipate that these pilot data and the novelty of the treatment will provide strong support for such an application. If it is found to be efficacious in a larger trial, the program could be validated in a space analogue setting and ultimately used on long-duration missions. Additionally, it could provide an immediate public health benefit across the United States.

Anticipated Benefits

The depression treatment program developed through this project has the potential to help individuals receive an evidence-based treatment for depression who would otherwise not have access to it.

Worldwide, depression is now the leading cause of disability, and in wealthier nations such as the United States, mental health disorders account for 4 of the 10 leading causes of lost productivity. A recent study of over 60,000 employees of large American companies found that 4.5% have high levels of psychological distress but that only 22% of them are receiving treatment. The annual cost to the United States in unearned income due to mental health disorders is \$193 billion. Nonetheless, successful treatment of mental disorders generally returns individuals to functioning comparable to those who have no history of mental health problems.

Effective, evidence-based treatments for depression do exist; however, there are major barriers to their widespread dissemination in the United States, including cost, transportation, availability, logistics, stigma, and training. The cost of behavioral health and psychiatric care is often borne directly by consumers and prohibitive for those with limited income. Moreover, the availability of services is limited, and many Americans lack adequate access to behavioral health professionals.

Logistics of travel and scheduling pose barriers to receiving behavioral health care on Earth as well as in space. Taking the time off from work, arranging childcare, and potentially traveling a great distance to appointments all conspire against individuals receiving a sufficient dose of behavioral intervention. Additionally, the stigma of asking for mental health care -- in self-perception and in social and employment consequences -- can prevent individuals from asking for help when it is needed on Earth, just as in space.

Finally, many Master's and Doctoral-level behavioral health professionals lack training in evidence-based treatment for depression. Practicing clinicians typically fail to adopt such treatments. Moreover, even when they are aware of the evidence-based guidelines and do attempt to provide them, the treatments are often not delivered effectively.

If ultimately found to be effective, the problem-solving treatment program developed through this project could help overcome the barriers of cost, availability, logistics, stigma, and training, while potentially facilitating major improvements in public mental health. It could be rolled out in a mass scale,

Technology Areas

Primary:

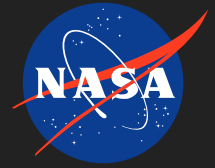
- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.3 Human Health and Performance
 - └ TX06.3.3 Behavioral Health and Performance

Target Destinations

The Moon, Mars

Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

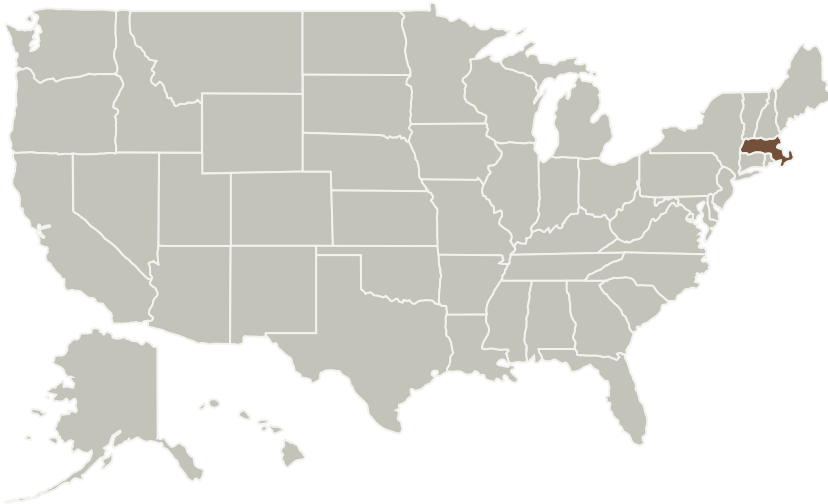
Completed Technology Project (2005 - 2009)



making an evidence-based treatment for depression available at any location, at any time.

This computer-based depression treatment, with simple modifications and revisions, could be adapted for use in other isolated operational environments, such as polar research stations, submarines, commercial ships, oil rigs, and underwater research bases. Furthermore, even greater value could be derived by making similar psychosocial support systems available to the public in settings such as primary care practices, public and mental health centers, schools, social services offices, places of worship, military bases, prisons, and eventually at home or in any location, through broadband Internet.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
National Space Biomedical Research Institute(NSBRI)	Lead Organization	Industry	Houston, Texas
Brigham And Women's Hospital, Inc.	Supporting Organization	Industry	Boston, Massachusetts
Dartmouth College	Supporting Organization	Academia	Hanover, New Hampshire
Harvard Medical School	Supporting Organization	Academia	Boston, Massachusetts

Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

Completed Technology Project (2005 - 2009)



Primary U.S. Work Locations

Massachusetts

Project Transitions

**January 2005:** Project Start**August 2009:** Closed out

Closeout Summary: During 2008-2009, we completed development and alpha-testing (debugging) of a depression treatment computer program. The program uses video, audio, graphics, and text to guide users through the steps of problem-solving treatment, and evidence-based treatment for depression. Users are guided through the treatment by Dr. Mark Hegel, a national expert in the intervention, who is presented via video and audio. The user's experience is tailored to his or her responses to questions, progress in the treatment, and depression level. Dr. Hegel asks questions and users respond via free text and menus. Each of the program's six sessions involves six steps. The efficacy of problem-solving treatment has been well-established in clinical settings, so our research questions were whether a computer program could be developed to deliver the intervention, and how efficacious it would be. If such a program could be built and is effective, it would be possible to provide a validated intervention to astronauts on long-duration missions who require treatment for depression. After completing development and alpha-testing, we conducted a pilot study to obtain an initial estimate of the program's efficacy. A randomized clinical trial was conducted with a small number of participants (N=14), of which 10 were female, 2 were Latino/Hispanic, and 1 was African American. The mean age was 50.5 years and all had completed at least 4 years of college, making them somewhat analogous to the astronaut population. Half of the participants were assigned to use the depression treatment program for 6 sessions, with a 1-week and 1-month follow-up. The other half were assigned to a wait-list control condition and re-evaluated after 7 weeks. (Note that not receiving a behavioral intervention is likely to be typical for astronauts with depression on long-duration missions, making the wait list a "treatment as usual" condition.) One of the control group participants dropped out of the study and 2 of the experimental group participants' data were omitted due to excessive lapses of time between sessions 3 and 4. The primary outcome was the Hamilton Depression Inventory, a standard measure of depression. No differences were found between groups at pre-test, and the mean for both groups was in the mild range of depression. A comparison of percent change from pre-test to post-test was made for the experimental (treatment) group and the control group. A significant difference ($p < .045$) was found between groups, with the experimental group improving more. The effect size was large (Cohen's $d = 1.73$). These results suggest that the depression treatment program may be efficacious for treating minor depression; however, a larger-sample clinical trial is required to confirm them.

Stories

Articles in Peer-reviewed Journals
(<https://techport.nasa.gov/file/64359>)

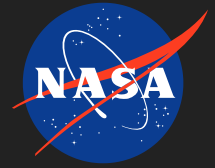
Articles in Peer-reviewed Journals
(<https://techport.nasa.gov/file/64358>)

Articles in Peer-reviewed Journals
(<https://techport.nasa.gov/file/64356>)

Articles in Peer-reviewed Journals
(<https://techport.nasa.gov/file/64357>)

Self-guided Depression Treatment on Long-duration Space Flights: A Continuation Study

Completed Technology Project (2005 - 2009)



Project Website:

<https://taskbook.nasaprs.com>